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Automatic Approach and Avoidance Tendencies in Pediatric Obsessive Compulsive Disorder

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy

in

Clinical Psychology

by

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The Dissertation of Jennie M. Kuckertz is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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ABSTRACT OF THE DISSERTATION

Automatic Approach and Avoidance Tendencies

in Pediatric Obsessive Compulsive Disorder

by

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Rationale. Treatment for children with obsessive compulsive disorder (OCD) involves deliberative approach of feared situations via exposure and response prevention, however a substantial proportion of youth do not respond. One potential explanation for the failure of deliberative approach of feared situations to result in

complete symptom reduction may be that patients also have prepotent, or automatic response tendencies to not approach or to avoid feared stimuli. Measures of automatic approach and avoidance biases have been developed and examined using standardized pictorial stimuli among populations with fairly homogenous fears. However, the highly heterogeneous nature of OCD symptoms suggests the need to utilize idiographic stimuli. The current pilot study represented an attempt to demonstrate initial feasibility, reliability, and preliminary validity of an idiographic measure of automatic approach and avoidance biases among children diagnosed with OCD.

Design. Participants (*N* = 17) included children ages 8-16 who were enrolled in two larger intervention studies. Symptom severity was assessed via clinician, child, and parent ratings from the Children's Yale Brown Obsessive Compulsive Scale. With the assistance of a clinician, parents and children worked collaboratively to identify threat pictures that triggered the child's OCD obsessions and/or compulsions, as well as emotionally neutral pictures. These pictures were utilized in an Approach Avoidance Task (AAT). In this computerized task, children were presented with threat and neutral pictures on the screen one at a time, framed by a blue or green border. Participants were instructed to respond by pushing or pulling a joystick based on the color of the picture border, which resulted in the picture becoming progressively smaller (simulating avoidance) or larger (simulating approach), respectively. Reaction times were measured for each combination of stimulus type and response direction, thus allowing for calculation of bias scores for different stimulus-response combinations. Aim 1: To characterize the nature of approach-avoidance tendencies in children with OCD. Aim 2:

To examine the relationship between approach-avoidance tendencies and OCD symptom severity.

Results. All participants were able to identify an appropriate number of threat and neutral pictures for use in the task. Split-half reliability coefficients for individual reaction time measures were high, as were correlations between individual reaction time measures. When examining bias scores, reliability was acceptable only for approach bias (pull threat minus pull neutral). Participants were significantly faster to pull threat pictures toward themselves when compared to reaction times for pulling neutral pictures toward themselves (approach bias). Moreover, participants demonstrated a larger approach-avoidance bias (i.e., reaction time difference for pushing minus pulling pictures of a given stimulus type) for threat compared to neutral stimuli. Both of these effects were statistically significant in the opposite direction as hypothesized. Participants did not demonstrate a statistically significant avoidance bias (push threat minus push neutral). No correlations between bias scores and OCD symptom severity reached statistical significance.

Conclusions. The current study demonstrates the feasibility of collecting idiographic stimuli from youth diagnosed with OCD, which had not yet been established in previous studies. Despite high reliability of individual reaction times, reliability of the bias scores may have been reduced by high correlations between individual reaction time means. Support for the hypothesized bias effects was limited. Establishing reliable measures of automatic approach and avoidance biases represents a critical area for continued research and a necessary step before firmer conclusions can be established about the nature of such biases or their relationship to symptoms.

CHAPTER 1: INTRODUCTION

1.1 Pediatric Obsessive Compulsive Disorder (OCD)

Obsessive compulsive disorder (OCD) is a psychiatric disorder characterized by intrusive thoughts, images, or impulses (i.e., obsessions) with subsequent urges to perform mental or overt acts designed to alleviate the anxiety associated with those obsessions (i.e., compulsions) (American Psychiatric Association, 2013). Epidemiological estimates suggest that approximately 1% of the population suffers from OCD within a 12-month period (Hofer et al., 2018; Ruscio, Stein, Chiu, & Kessler, 2010; Torres et al., 2006), with higher rates for lifetime diagnosis (Ruscio et al., 2010) and subclinical features of the disorder (Adam, Meinlschmidt, Gloster, & Lieb, 2012). Children with OCD experience significant functional impairment across school, social, and family domains (Piacentini, Bergman, Keller, & McCracken, 2003). Thus, OCD in children is associated with pervasive impairment across multiple areas of functioning.

Twenty-five percent of individuals diagnosed with OCD experience onset prior to age 14, and 50% experience onset prior to age 19 (Kessler et al., 2005). For those diagnosed with OCD in childhood, the course is chronic and may confer risk for later additional psychopathology (Flament et al., 1990; H. Thomsen, 1994; Wewetzer et al., 2001). For example, one study found that among individuals diagnosed with OCD in childhood or adolescence, 36% continued to meet criteria for OCD and 71% met criteria for another psychiatric disorder when re-assessed in adulthood (Wewetzer et al., 2001). Considering both the chronicity of this disorder as well the functional impairments associated with OCD, there is a need to understand better and intervene faster during pediatric OCD due to its pressing public health concern.

1.2 Deliberative Approach and Avoidance of Threat in Treatment of Pediatric OCD

Broad consensus exists that cognitive behavioral therapy (CBT) with an emphasis on exposure and response prevention (ERP) is the treatment of choice for pediatric OCD, and is efficacious either as a stand-alone intervention or when combined with selective serotonin reuptake inhibitors (AACAP, 2012; Freeman et al., 2014; Jordan, Reid, Mariaskin, Augusto, & Sulkowski, 2012). As the terms CBT and ERP are often used interchangeably in the context of treatment for OCD (Abramowitz, Taylor, & McKay, 2005; Allen, 2006), the intervention is hereafter referred to as ERP as it specifically denotes an emphasis on completion of exposure exercises. ERP, as the name denotes, comprises two primary areas of emphasis, including (1) facilitating deliberative approach of/engagement with feared situations, and (2) refraining from avoidance/escape responses, including rituals designed to alleviate anxiety associated with the feared situations. For example, a child with OCD who fears becoming poisoned might be encouraged to deliberatively approach a bottle of bleach (e.g., holding bottle, opening cap) and to deliberatively override the desire to avoid the bleach (e.g., not backing away, not leaving the room, not washing hands after touching the bottle).

Despite its status as the first-line treatment for pediatric OCD, ERP does not result in complete symptom reduction for a substantial proportion of youth with OCD. For example, in one of the largest treatment outcome studies in youth with OCD, 60% of youths receiving ERP failed to remit (POTS, 2004). Across a number of studies, weekly ERP produces 38-57% reduction in pediatric OCD symptoms (Bolton et al., 2011; Bolton & Perrin, 2008; Piacentini et al., 2011; Storch et al., 2007, 2013) as measured by the Children's Yale-Brown Obsessive Compulsive Scale (CYBOCS; Scahill et al., 1997).

These data suggest that mechanisms beyond deliberative approach and avoidance of threat may contribute to the maintenance of OCD symptoms.

One potential explanation for the apparent failure of deliberative approach of feared situations to result in complete symptom reduction may be that patients also have prepotent, or automatic response tendencies to not approach or to avoid feared stimuli. Such automatic response tendencies may not be fully modified by deliberative approach of threat and thus may impair generalization of approach of feared situations outside of session. Though this phenomenon has received limited empirical investigation, it has been anecdotally described by clinicians, researchers, and patients as “white knuckling it” through an exposure and has generally been regarded as a barrier to treatment response (Gurak, Freund, & Ironson, 2016; J. Heeren & Berryhill, 2018; Murray, McHugh, & Otto, 2010; Williams, Dooseman, & Kleifield, 1984). That is, given the time, motivation, and pressure of an exposure situation with a clinician, the patient may be able to temporarily override these automatic approach or avoidance tendencies. However, in real life when confronted with feared stimuli unexpectedly, the individual’s reaction may be more aligned with their prepotent response tendencies. In this manner, OCD symptoms may be maintained.

1.3 Relationship Between Automatic Biases and Real-World Behavior

The notion that behavior in real world settings is dictated not only by deliberative but also automatic processes has long been demonstrated in the social psychology literature. A large body of research suggests that racial biases measured automatically via reaction time tasks are predictive of actual behavior towards individuals of minority racial status (e.g., Amodio & Devine, 2006; Dovidio et al., 1997; McConnell & Leibold, 2001). For example, McConnell and Leibold (2001) examined the associations between actual participant behavior towards white and Black experimenters with automatic racial bias. When deceiving white participants regarding the true nature of the experiment, McConnell and Leibold found that more negative automatic bias towards Blacks was predictive of more negative social interactions with Black experimenters. Moreover, automatic biases may be particularly predictive of behavior under conditions that allow for little time to deliberate or when individuals experience high cognitive load (Dovidio et al., 1997). For example, Dovidio and colleagues (1997) found that explicitly endorsed racial biases were most predictive of race-related behavior when participants had the ability to consciously deliberate, however automatic biases as measured via a reaction time task were most predictive of responses when participants were required to respond to race-related situations in a speeded manner and under high cognitive load.

Together, these studies suggest that automatic biases may be particularly predictive of behavior when individuals are unaware that they are being tested, when the required response is speeded, or under conditions of high cognitive load. Such findings from the social psychology literature may also be relevant to the treatment of children with OCD. It is possible that a child's explicit intentions to approach feared situations may lead to actual approach of feared situations for in-office exposure sessions when participants are being observed by a therapist and have time to plan the exposure to be completed. However, in real world situations in which children may be faced unexpectedly with feared stimuli, it is possible that more automatic biases not to approach and/or to avoid will be most determinative of actual behavior.

1.4 Measurement of Automatic Action Tendencies

Social psychology researchers have argued that measurement of motor movements can be assessed automatically via reaction time tasks and may be a more proximal predictor of biased real-world behavior relative to other automatic bias tasks that are designed to assess biased cognition (i.e., attitudes) but not directly behaviors (Paladino & Castelli, 2008). The reflective impulsive model of behavior (Strack & Deutsch, 2004) posits that stimuli in one's environment elicit automatic evaluations that activate affectively congruent behavioral schemas of approach and avoidance (i.e., automatic action tendencies). In contrast to deliberative, effortful control of behavior, automatic action tendencies may be described as more implicit and immediate reactions to approach or avoid negative stimuli based on prepotent responses.

Specifically, automatic action tendencies can be operationalized and assessed indirectly through reaction time measurements for arm flexion (approach) and extension (avoidance) (Cacioppo, Priester, & Berntson, 1993; Solarz, 1960). In an early investigation of this phenomenon, Solarz (1960) reported that participants were faster to initiate movement when instructions to move a word towards or away from themselves were compatible with the word meaning (i.e., "tasty"-towards; "putrid"-away) versus when the movements were incompatible with the word meaning (i.e., "tasty"-away; "putrid-towards"). A number of subsequent studies have demonstrated that positive stimuli and attitudes are associated with faster arm flexion than arm extension, whereas negative stimuli and attitudes are associated with faster arm extension than arm flexion (Cacioppo et al., 1993; Chen & Bargh, 1999; Neumann, Hülsenbeck, & Seibt, 2004). Although initial investigation of automatic action tendencies was based on the evolutionary psychology notion that the actual movement of arm flexion was more compatible with positive stimuli and arm extension with negative stimuli (Cacioppo et al., 1993; James, 1884), later research has suggested that it is the interpretation of approach or avoidance that is critical and hence associated with speeded or slowed response (Phaf, Mohr, Rotteveel, & Wicherts, 2014; Seibt, Neumann, Nussinson, & Strack, 2008). For example, participants may show speeded arm extension (relative to arm flexion) when the experiment is framed such that arm flexion represents bringing a positive object closer to their body, but speeded arm extension (relative to arm flexion) when the experiment is framed such that arm extension represents moving their body towards something positive on the computer screen (Seibt et al., 2008).

Arm flexion/extension tasks designed to measure automatic action tendencies have been labeled Approach Avoidance Tasks (AAT; for reviews see (Phaf et al., 2014; Roefs et al., 2011) The AAT frequently includes valenced and neutral pictorial stimuli as well as a “zooming” feature, such that pictures become progressively larger when a joystick is pulled toward a participant, simulating actual approach, and progressively smaller when pushed away from the participant, simulating actual avoidance (Rinck & Becker, 2007). Participants are typically asked to respond by pushing or pulling a joystick based on a content-irrelevant feature of the picture (i.e., whether the border color is blue or green; picture format landscape or portrait). Thus any effect of the picture valence on the participant’s reaction time is measured at an automatic level because the task does not involve instructions based on the valence of stimuli.

1.5 Automatic Action Tendencies and Psychopathology

Research suggests that individuals with clinical or subclinical levels of psychopathology demonstrate biased patterns of automatic action tendencies consistent with their disorder. Rinck and Becker (2007) conducted the first study examining automatic action tendencies in individuals with anxiety. Similar to previous AAT studies, participants with and without spider fear saw emotionally salient (i.e., spiders) and neutral pictures (e.g., chairs) on the computer screen one at a time. Participants responded to each picture by pulling or pushing a joystick based on whether the picture was in portrait or landscape format. These researchers operationally defined automatic approach or avoidance tendencies by comparing the reaction times for pulling versus pushing within a given valence category (i.e., pulling spider pictures compared to pushing spider pictures), and found that spider fearful participants were slower to pull versus push spider pictures, whereas this effect was absent for neutral pictures. The effect for spider pictures was also absent in non spider-fearful participants. Other researchers have obtained similar results in adults with social anxiety (Heuer, Rinck, & Becker, 2007; Roelofs et al., 2010; Voncken, Rinck, Deckers, & Lange, 2012) and children with spider fear (Klein, Becker, & Rinck, 2011).

For individuals affected by disorders associated with dysfunctional approach of appetitive stimuli, studies utilizing the AAT have also found disorder-congruent patterns of approach and avoidance. For example, Cousijn, Goudriaan, and Wiers (2011) found that heavy cannabis users were faster to pull cannabis pictures towards themselves relative to pushing these pictures away from themselves, whereas this effect was not present for neutral pictures. The bias for cannabis pictures also did not exist in non-cannabis users. Similar findings have been reported among heavy cigarette smokers (C. E. Wiers et al., 2013) and heavy drinkers with a particular genotype (R. W. Wiers, Rinck, Dictus, & Van Den Wildenberg, 2009).

Although the question of group differences in various approach and avoidance biases between clinical and control populations is informative at a theoretical level, the relationship between these biases and symptom severity at the individual level may be of greater clinical relevance. Such information could potentially be used to tailor better interventions and target purported mechanisms of treatment. Indeed, biased automatic action tendencies not only show disorder-congruent patterns of approach or avoidance, but also show associations with symptom severity across a variety of disorders. For example, among a mixed sample of children diagnosed with an anxiety disorder, strength of automatic avoidance tendencies for emotional faces versus neutral faces was associated with clinician-rated youth anxiety severity (Kuckertz, Carmona, Chang, Piacentini, & Amir, 2015). Automatic approach and/or avoidance biases are also associated with symptom severity among adults with social anxiety disorder (Kuckertz, Strege, & Amir, 2017) and heavy cigarette smokers (C. E. Wiers et al., 2013).

1.6 Automatic Action Tendencies and OCD

While a number of studies have examined automatic action tendencies among anxious individuals, only two have examined these biases among individuals with elevated obsessive-compulsive symptoms (Amir, Kuckertz, & Najmi, 2013; Najmi, Kuckertz, & Amir, 2010). Two additional studies demonstrated the feasibility of using an AAT training paradigm among participants diagnosed with OCD, however bias scores were not reported in these studies (Amir, Kuckertz, Najmi, & Conley, 2015; Weil, Feist, Moritz, & Wittekind, 2017). Najmi and colleagues (2010) presented undergraduate students high and low in obsessive-compulsive contamination fears with contamination-related and neutral pictures on a computer screen one at a time. Participants responded to each picture by pulling or pushing a joystick based on an irrelevant feature of each picture (e.g., picture border color – blue or green). Participants high in contamination fears demonstrated greater difficulty (i.e., longer reaction times) in pulling contamination-related pictures relative to neutral pictures (i.e., approach bias index), whereas this difference was not significant among participants low in contamination fears. Moreover, this study reported an association between contamination fears and the automatic approach bias index whereby greater difficulty approaching contamination-related versus neutral pictures was associated with greater severity of self-reported contamination fears.

Idiographic assessment. To date, AAT biases have only been examined using standardized pictorial stimuli matched on a variety of stimulus-level features among populations with fairly homogenous fears. However, the highly heterogeneous nature of OCD presenting symptoms renders particular challenges to studying automatic action tendencies in this population. Although a number of studies have used idiographically-selected stimuli in information processing tasks for OCD, such studies have generally used word stimuli (Amir, Najmi, & Morrison, 2009; Foa & McNally, 1986) or stimuli for more strategic processes (e.g., conscious memory, Tolin et al., 2001; behavioral approach test, Steketee et al., 1996). In one study, adults with OCD selected idiographic threat and neutral pictures for use in an AAT training task delivered as part of a larger cognitive bias modification package, however, the authors did not include an AAT assessment task (Amir et al., 2015). Therefore, it remains to be determined whether AAT tasks will yield differences between threat and neutral pictures for automatic action tendencies in OCD. This question is of particular import given a recent review highlighting the importance of using idiographic stimuli in the assessment of OCD-related information processing biases (Hezel & McNally, 2016).

Furthermore, previous studies have used idiographic stimuli for information processing tasks in the context of adult OCD research. Thus, the feasibility of collecting and using idiographic stimuli has not yet been established for children with OCD (self-report measures represent an exception; e.g., Farrell & Barrett, 2006), who may have greater difficulty relative to adults in describing their thoughts and identifying pictures representing relatively abstract obsessions.

Psychometric issues in measurement. Automatic action tendencies have been conceptualized under the broad umbrella of cognitive biases (Kakoschke, Kemps, & Tiggemann, 2017; R. W. Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). The majority of cognitive bias paradigms, including the AAT, yield bias scores based on reaction time differences for disorder-congruent or incongruent responses to threat and neutral stimuli. In recent years, researchers have called for increased scrutiny of the psychometric properties of commonly used cognitive bias measures (Kuckertz & Amir, 2015; Lilienfeld, 2014; Rodebaugh et al., 2016), some of which demonstrate poor internal consistency and test-retest reliability that tends towards zero (Kappenman et al., 2014; Price et al., 2015; Schmukle, 2005; Staugaard, 2009). To date, very few studies have reported the reliability of AAT bias scores (Reddy, Green, Wynn, Rinck, & Horan, 2016; Reinecke, Becker, & Rinck, 2010; Rinck & Becker, 2007).

As a basic tenant of classical test theory is that the reliability of a given measure (i.e., consistency with which a measure correlates with itself) typically sets the upper limit on its validity (i.e., consistency with which a measure correlates with another measure) (Nunnally, 1978), demonstration of reliability is a requisite step in examining the relationship between cognitive bias measures with symptoms. As such, researchers have increasingly called for the development of novel and reliable measures of cognitive biases (MacLeod & Clarke, 2015), while also highlighting the components necessary to produce a reliable difference (i.e., bias) score (Rodebaugh et al., 2016). The reliability of any difference score measure is increased or decreased as a function of (1) the reliability of each individual score included in the difference score, and (2) the correlation between the two individual scores included in the difference score (Furr & Bacharach, 2014). That is, a difference score will only be reliable if the individual scores are themselves reliable but not highly correlated.

Theoretically, utilization of idiographic as compared to standardized stimuli may strengthen the reliability of a difference score (e.g., approach and avoidance biases). Standardized stimuli may contain some degree of ambiguity in terms of how participants interpret and respond to those stimuli in relation to other stimuli (e.g., Kuckertz et al., 2017), whereas idiographically-selected stimuli may have relatively fixed meanings for individual participants and hence elicit more consistent (i.e., more reliable) responding. Additionally, as idiographic selection of both threat and neutral stimuli is designed to maximize the discrepancy between types of emotional reactions to those stimulus types, so too may this increase the likelihood for a reduced correlation between reaction time responding for those stimulus types.

Conceptual issues in measurement. Traditionally, AAT researchers have conceptualized automatic action tendencies as falling along a single dimension ranging from approach to avoidance. Most typically, a bias score is calculated as a difference between average reaction times for pushing a joystick versus pulling a joystick in response to a particular stimulus type (e.g., Rinck & Becker, 2007). Under this model, individuals who have a positive bias score are said to have an approach bias (e.g., alcohol; R. W. Wiers, Rinck, Kordts, Houben, & Strack, 2010), whereas individuals with a negative bias score are said to have an avoidance bias (e.g., spiders; Rinck & Becker, 2007). This bias is often contrasted with non-significant bias scores for non-disorder relevant stimuli (e.g., Rinck & Becker, 2007).

Najmi and colleagues (2010) argued that approach and avoidance tendencies in the context of AAT are best conceptualized as separate constructs. In their study of individuals with high levels of obsessive-compulsive contamination fear, they argued that one may have difficulty approaching feared contamination-related stimuli (i.e., pulling joystick) and/or a tendency to avoid such stimuli (i.e., pushing joystick). As these authors point out, traditional methods of calculating bias scores within a given stimulus category fail to differentiate between difficulty with approach versus speeded avoidance. The authors introduced an alternate bias calculation method for separate approach and avoidance biases. Approach and avoidance biases are thus represented as the difference in reaction times for disorder-relevant stimuli minus neutral stimuli within a given response direction (i.e., pull threat – pull neutral; push threat – push neutral). Moreover, as certain populations may have both an approach and avoidance tendency for the same stimulus type (R. W. Wiers et al., 2010), this may yield null results when calculating a push-pull difference score. However, these seemingly distinct tendencies would be captured using separate approach and avoidance bias scores, thus leading to the development of a more specific model of behavioral action tendencies for that disorder. Researchers have demonstrated the validity of this bias score calculation method among various populations (e.g., socially anxious adults: Voncken et al., 2012; depressed adults: Bartoszek & Winer, 2015; spider fearful adults: Bartoszek & Winer, 2015; adults with post-traumatic stress disorder: Wittekind et al., 2015).

Calculation of separate bias scores for automatic approach and avoidance has been validated in a clinically anxious pediatric population. In a study by Kuckertz and colleagues (2015), clinically anxious youth with mixed anxiety diagnoses completed an AAT in which they responded by pulling or pushing pictures of neutral, smiling, or disgust faces based on the color of the picture border. Results revealed that faster pushing (i.e., avoidance) of both disgust and smiling faces relative to neutral faces was associated with greater clinician-rated anxiety severity. Approach biases for both smiling and disgust faces were also associated with anxiety severity in the expected direction, although these effects failed to reach traditional levels of statistical significance.

While the advantage of calculating separate automatic approach and avoidance scores over a single approach-avoidance index has been argued from both a theoretical and empirical standpoint, special consideration of this issue is warranted in the case of OCD. Given that assessment of automatic action tendencies may be most robust for OCD using idiographic pictures that are difficult to match to neutral pictures based on stimulus features (as reviewed above), comparisons of push/pull reaction times within a given valence category may better control for stimulus characteristics when compared to threat and neutral pictures within a given response direction. The comparative utility of these alternate approaches in the case of OCD may be preliminarily examined by correlating each of these bias scores with OCD symptom severity.

Sections of Chapter 1 of this dissertation will be submitted for publication with co-author, Amir, Nader. The dissertation author was the primary investigator and will be the primary author on this publication.

CHAPTER 2: DISSERTATION AIMS

Researchers have developed the AAT as a measure of automatic approach and avoidance and demonstrated the presence of biased action tendencies among individuals with elevated obsessive-compulsive and anxiety symptoms. Preliminary research suggests that these biases may be associated with anxiety severity in some populations. However, biased automatic action tendencies have not been examined in a clinical sample diagnosed with OCD nor using idiographically-selected stimuli. Given that individuals with OCD present with highly heterogeneous symptoms, automatic action tendencies may be best measured using personalized stimuli. Development of reliable and valid measures of biased automatic action tendencies for pediatric OCD is critical to further study automatic versus deliberative mechanisms of approach and avoidance involved in the maintenance of OCD symptoms. Such research may ultimately allow for more targeted manipulation of treatment mechanisms.

The current study represented an initial attempt to establish the feasibility of using the AAT with idiographically-selected stimuli, provide evidence of reliability for AAT bias scores, and demonstrate very preliminary validity of the AAT bias scores among a small sample of children with OCD. Participants (N = 17) ages 8-17 with a primary diagnosis of OCD worked collaboratively with their parent and a clinician to identify threat-relevant pictures that represented their OCD feared situations as well as emotionally neutral pictures. Using these pictures, participants completed an AAT assessment task in which they were required to pull (approach) or push (avoid) a joystick in response to the color of a border frame surrounding the threat-relevant and neutral pictures. I hypothesized that participants' reaction times would differ for responses to threat-relevant versus neutral stimuli in each response direction (approach, avoid), and that participants would differ in reaction times for approaching versus avoiding threat-relevant stimuli. I also hypothesized that AAT bias scores would be correlated with symptom severity. Specific aims and hypotheses are outlined below:

2.1 Aims and Hypotheses

Aim 1. To characterize the nature of approach-avoidance tendencies in children with OCD.

Aim 1 hypotheses. I hypothesized that participants would be significantly slower to approach threat compared to neutral pictures (Hypothesis 1a), significantly faster to avoid threat compared to neutral pictures (Hypothesis 1b), and significantly slower to approach than to avoid threat pictures (Hypothesis 1c). Moreover, I hypothesized that the approach avoidance (AA) bias (i.e., reaction time for pushing – reaction time for pulling within a given valence category) would be significantly smaller (i.e., more negative) for threat relative to neutral pictures (Hypothesis 1d).

Aim 2. To examine the relationship between approach-avoidance tendencies and OCD symptom severity.

Aim 2 hypotheses. I hypothesized that approach bias would correlate with symptom severity such that greater difficulty approaching threat relative to neutral pictures would correspond with greater symptom severity (Hypothesis 2a), avoidance bias would correlate with symptom severity such that greater tendencies to avoid threat relative to neutral pictures would correspond with greater symptom severity (Hypothesis 2b), and threat AA bias would correlate with symptom severity such that slower responses to approach versus avoid threat pictures would correspond with greater symptom severity (Hypothesis 2c).

2.2 Analysis of Aims

Main analyses were conducted in SPSS version 24 (IBM Corp, 2016). Power analyses were run using G*Power version 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). Given the preliminary nature of and small sample size for the current study, the study was only powered to detect medium- to large-sized effects, as demonstrated below. For this reason I also elected not to utilize corrections for multiple comparisons, and thus all reported effects should be interpreted in light of this limitation.

Analysis of Aim 1. To characterize the nature of approach-avoidance tendencies in children with OCD, I examined each of the following bias scores: (1) approach bias (pull threat vs. pull neutral), (2) avoidance bias (push threat vs. push neutral), and (3) threat AA bias (push threat vs. pull threat). Mean reaction times within a given bias domain were compared with a paired samples *t* test. I also compared AA threat bias to AA neutral bias (push threat vs. pull threat) with a paired samples *t* test. Given $N = 17$ participants, $\alpha = .05$, and two-sided test, I achieved 80% power to detect a medium- to large-sized effect ($d = 0.73$).[1] This exceeds the expected effect size based on a previous study using a similar version of this task (Najmi et al., 2010, $d = 0.56$).

Analysis of Aim 2. To examine the relationship between approach-avoidance tendencies and OCD symptom severity, I examined whether each of the following bias scores correlated with CYBOCS total score using bivariate (Pearson) correlations:

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[1] Consistent with G*Power methodology, I report Cohen's *d* throughout the manuscript based on the following formula for dependent samples design: $d = t$/square root of n (Lakens, 2013). Effects sizes will be interpreted as follows: small ($d = .02$), medium ($d = .05$), or large ($d = .08$) (Cohen, 1988).

automatic approach bias, automatic avoidance bias, and threat AA bias. Given $N = 17$ participants, $\alpha = .05$, and two-sided test, I achieved 80% power to detect a large-sized effect ($r = 0.62$). This exceeds the expected effect size for the relationship between symptoms and bias scores from previous studies using similar versions of this task (Najmi et al., 2010, $r = .45$; Kuckertz et al., 2017, $r = 0.42$).

Sections of Chapter 2 of this dissertation will be submitted for publication with co-author, Amir, Nader. The dissertation author was the primary investigator and will be the primary author on this publication.

CHAPTER 3: METHODS

3.1 Study Overview

Participants included 17 children diagnosed with OCD and their parents/legal guardians, who were recruited and assessed through two larger intervention studies at the San Diego State University (SDSU) Center for Understanding and Treating Anxiety (CUTA). Participants completed an initial assessment battery of clinician-rated, child-rated, parent-rated, and behavioral (i.e., AAT assessment tasks) measures. Data from the initial assessment was used to examine the aims of the current study.

3.2 Participants

Recruitment. All procedures for recruitment and informed consent were reviewed and approved by the SDSU Institutional Review Board (IRB). Once parents initiated contact with study staff they were provided with a brief study overview of the project, and if interested, underwent initial eligibility screening using an IRB-approved telephone screening script. Eligible families who were interested in participating were scheduled for an initial appointment (*N* = 32). Of these 32 scheduled intakes, eight families cancelled or did not show up to the appointment and one family attended the intake but the child was unwilling to continue answering questions, resulting in 23 families who completed the intake. Of these 23 completed intakes, four participants were ineligible (*n* = 2 subclinical severity, *n* = 1 substance use disorder, *n* = 1 parent unable to participate) and one participant was eligible but decided not to enroll, resulting in 18 participants who agreed to participate. One additional participant later chose to discontinue participation early in the baseline assessment process. In total, 17 participants completed all assessments analyzed in the current dissertation.

Recruitment sources for included participants were as follows: therapist, school counselor, or psychiatrist (*n* = 9), online search (*n* = 6), study flyer (*n* = 2), recruited through advertisements for another study in the same laboratory (*n* = 1), and referred by a friend (*n* = 1). The sum of numbers from each of these recruitment sources exceeds the number of participants enrolled in the study because some participants inquired about the research study after having learned of the study from multiple sources.

Inclusion/exclusion criteria. Inclusion criteria were as follows: (a) children 8 to 17 years of age, (b) met DSM-IV diagnostic criteria for obsessive compulsive disorder, (c) CYBOCS $\geq$ 16, (d) parent or legal guardian of child participant who was capable and willing to participate in the study, and (e) child and parent/guardian had English proficiency. Exclusion criteria were as follows: (a) active suicidality or recent suicide attempt, (b) prior diagnosis of psychosis, bipolar disorder or substance abuse/dependence, (c) organic mental disorder, defined as previous diagnosis of intellectual disability, enrollment in special education curriculum due to intellectual disability, and/or grade equivalency below the minimum threshold for study participation (e.g., second grade), (d) developmental disorder, (e) change in psychotropic medication within the past 6 weeks, (f) concurrent psychotherapy, (g) serious medical conditions that would interfere with study participation, and (h) other medications, herbals, or over-the-counter medications that would interfere with interpretation of the study. Children with other comorbid disorders (e.g., anxiety, attention deficit hyperactivity disorder, oppositional defiant disorder, tic disorder) were eligible if these disorders were secondary to OCD determined based on level of severity and impairment caused by each condition.

3.3 Measures[2]

Anxiety Disorders Interview Schedule. The Anxiety Disorders Interview Schedule for DSM-IV-Child and Parent versions (ADIS-IV-C/P; Silverman & Albano, 1996) is a semi-structured interview administered to youth and their parents designed to obtain diagnostic information based on the Diagnostic and Statistical Manual-IV (DSM-IV; American Psychiatric Association, 1994), including mood, anxiety, and externalizing disorders. The ADIS-IV-C/P has strong evidence for concurrent validity for anxiety diagnoses (Wood, Piacentini, Lindsey Bergman, McCracken, & Barrios, 2002), excellent inter-rater agreement for principal diagnosis (k = 0.92; (Lyneham, Abbott, & Rapee, 2007), and excellent test-retest reliability for anxiety disorder diagnoses (k = .80-.92; Silverman, Saavedera, & Pina, 2001).

Because the DSM-5 version of this measure was not available at study initiation, participants were considered eligible for participation based on DSM-IV criteria as defined by ADIS-IV-C/P. DSM-IV and DSM-5 criteria for OCD differ (a) in terms of specifiers and (b) patient no longer needs to recognize their obsessions or compulsions as excessive or unreasonable. The ADIS-IV-C/P does not assess specifiers and does not have a question directly assessing whether the child views their obsessions or compulsions as excessive or unreasonable, therefore I did not expect this interview tool to yield differential OCD diagnoses based on DSM-IV versus DSM-5 criteria.

Children's Yale-Brown Obsessive Compulsive Scale. The Children's Yale-Brown Obsessive Compulsive Scale (CYBOCS) (Scahill et al., 1997) is a clinician-rated

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[2] For the purposes of clinical characterization, participants completed the child- and parent-rated versions of the Screen for Child Anxiety Related Emotional Disorders (SCARED-C and SCARED-P; Birmaher et al., 1999) and Mood and Feelings Questionnaire (MFQ-C and MFQ-P; Costello & Angold, 1988). The clinician also rated the Clinical Global Inventory-Severity scale (CGI-S; Guy, 1976) for each participant.

measure of obsessive-compulsive symptom severity in youth and is adapted from the adult version of this measure (Goodman et al., 1989). The scale comprises 10 items, which make up an obsessions subscale and a compulsions subscale that are summed to yield a total score. Items are scored on a 0–4 scale, with higher scores indicating greater severity of obsessions and compulsions. Total CYBOCS scores $\geq$ 16 are commonly considered indicative of a diagnosis of OCD and a standard inclusion criterion for clinical trials (Piacentini et al., 2011; Storch et al., 2007; P. H. Thomsen et al., 2013). The CYBOCS total score demonstrates excellent internal consistency (α = 0.90), test-retest reliability (ICC = 0.79), and convergent/divergent validity (Storch et al., 2004). In this study, internal consistency for the CYBOCS was good (alpha = .87).

CYBOCS Child- and Parent-Report Versions. The CYBOCS Child-Report (CYBOCS-C) and CYBOCS Parent-Report (CYBOCS-P) (Piacentini, Langley, & Roblek, 2007)versions parallel the CYBOCS clinician-rated measure in content, number of items, and rating scale. The CYBOCS-C correlates highly with the clinician-administered measure (*r* = .77; (Conelea, Schmidt, Leonard, Riemann, & Cahill, 2012). In this study, internal consistency for the CYBOCS was acceptable for the child (alpha = .71) and good for the parent (alpha = .82) versions.

AAT. Participants completed an AAT to assess automatic action tendencies in response to idiographically-selected OCD threat-related pictures and neutral pictures. Consistent with previous research using the AAT (e.g., Amir et al., 2013; Kuckertz et al., 2015, 2016; Najmi et al., 2010), colored frames bordering each picture guided the participants' direction of movement. All pictures were framed by a blue or green border. Participants sat in front of a computer screen, with a joystick situated on the desk between the monitor and the participant. A research assistant instructed each participant that they would see a series of pictures with different colored borders, and that for each picture they should pull the joystick if the border was green and push the joystick if the border was blue (Figure 1). Thus, participants responded only to the color of the border framing each picture rather than to the content within the image itself. Half the pictures with each of the two border colors were threat-related, and half the pictures were neutral.

The AAT assessment task comprised 192 trials (8 Pictures x 2 Picture Type [threat, neutral] x 2 Border Color [green, blue] x 6 Repetition) presented in a new random order to each participant. To begin each trial, participants pressed a button on the joystick that resulted in the appearance of a medium-sized picture in the center of the screen. In each trial, the picture became increasingly larger if the participant pulled the joystick, simulating approach, and decreasingly smaller if the participant pushed the joystick, simulating avoidance. When the joystick reached approximately a 30° position in either direction, the picture disappeared, regardless of whether the participant responded correctly. The next trial began when the joystick was brought fully back to the central position. Reaction times were calculated on the basis of the length of time the image remained on the screen, that is, from the time the picture appeared on the screen to the time it disappeared.

As reviewed in the introduction, bias scores were calculated based on (1) approach and avoidance as separate constructs (Najmi et al., 2010) and (2) approach-avoidance as a single dimension (Rinck & Becker, 2007). Thus, a total four bias scores were calculated based on comparisons of mean reaction times: (1) approach bias =

difference between pulling threat pictures minus pulling neutral pictures, with higher scores indicating greater difficulty approaching threat relative to neutral stimuli; (2) avoidance bias = difference between pushing threat pictures minus pushing neutral pictures, with lower sores indicating greater avoidance (i.e., escape) of threat relative to neutral stimuli; (3) threat approach-avoidance (AA) bias = difference between pushing threat pictures minus pulling threat pictures, with lower scores indicating greater difficulty approaching relative to avoiding threat stimuli; (4) neutral AA bias = difference between pushing neutral pictures and pulling neutral pictures, with lower scores indicating greater difficulty approaching relative to avoiding neutral stimuli.

Prior to completing the assessment AAT, participants completed a practice AAT consisting of 16 trials using novel neutral stimuli. A research assistant was present and provided corrective feedback if the participant did not respond correctly to border color instructions or appeared to be consistently responding outside the expected data analysis window for reaction times (e.g., greater than 2-3 seconds). If the participant did not correctly and consistently respond to the border color in the practice task, the research assistant asked the participant to complete the practice task again.

3.4 Baseline Assessment Procedure

At the beginning of the initial intake session, parental permission and child assent forms were provided to and reviewed with parents and children to ensure adequate understanding of the study purpose, procedures, risks, potential benefits, and limitations to confidentiality. Parents and children were interviewed together for the CYBOCS and ADIS assessments unless (a) indicated by either parent or child that they would prefer separate interviews, or (b) clinically indicated to conduct separate interviews. Joint interviewing procedures have been successfully implemented in our previous work (Carmona et al., 2015; Kuckertz et al., 2015) as well as that of others (Peris & Piacentini, 2013; Piacentini et al., 2011). Following the clinical interview, the clinician, in consultation with the clinic director (Dr. Amir) as needed, made a determination regarding study eligibility. Ineligible families received a list of community referrals. Eligible families were offered the opportunity to enroll in the study and if enrolled, completed remaining assessments over two additional sessions. AAT stimuli were finalized in the second session. Participants completed the idiographic assessment AAT at the third session, thus allowing time to create the program for each participant.

3.5 Stimuli Collection Procedure[3]

Eligible participants provided stimuli for the AAT during the pre-assessment process, including eight neutral and at least eight idiographic OCD-related pictures.[4] At the end of the initial intake session and after completing both the CYBOCS and ADIS, the clinician explained the stimuli collection procedure, noting that, “some of our computer programs that you will be doing are unique for you personally. This means that we need your help coming up with pictures that have to do with your OCD.” The clinician further explained that the participant and their parent should provide pictures that trigger the child’s OCD thoughts and/or rituals, “get your OCD going,” and elicit a negative reaction. Based on symptoms endorsed during the CYBOCS, the clinician helped the parent and child brainstorm examples of pictures that they could provide.

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[3] This section describes the procedure for the majority of participants (*n* = 11), who were enrolled in the second study. In the earlier study (*n* = 6) there were several differences in stimuli collection procedure, including: 1) participants selected neutral images from a web search rather than the IAPS, 2) participant were allowed to select threat and neutral pictures not matched for number of pictures with people (*n* = 4).

[4] Eight threat and eight neutral pictures were utilized for the AAT assessment described here, however participants identified a total of at least 22 threat and 22 neutral pictures to be used for a separate task as part of the larger studies.

The clinician explained that the family could chose to either download pictures from a web search or take pictures themselves, depending on which would better represent the child's feared situations. In addition to verbal instructions, parents and children were given written material explaining the picture collection process and how to email pictures to the clinician. Families were required to send the pictures to the clinician at least two days prior to the following appointment.

At the beginning of the second appointment, the clinician reviewed the threat pictures that were sent by the family. The clinician informally queried both parents and children with their experience collecting pictures. Many parents anecdotally described that the child experienced anxiety over finding pictures (e.g., looking at pictures with suggestive content such as underwear ads) or creating a situation of which to take a picture (e.g., taking a picture of parent touching child's keyboard). All families in the study were able to send threat pictures prior to this appointment. In one instance, the participant indicated that several of the pictures that the family identified were too triggering and so these pictures were replaced by pictures that were somewhat less threatening. Although families generally provided an adequate number of appropriate pictures, on several occasions the clinician worked collaboratively with the child to identify additional threat pictures if the (1) pictures were very pixelated when zoomed in, (2) pictures could not be re-formatted to square shape without significant distortion, or (3) child reported that pictures were not very threatening.

The clinician also identified emotionally neutral pictures collaboratively with the child. Using age-appropriate language, the clinician explained that the goal was to find pictures that did not make the child feel either positively or negatively – in other words, pictures for which the child had no particular emotional reaction. During this time, the clinician reviewed 87 pre-selected pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) and asked the child to identify which pictures elicited no emotional reaction. This candidate pool of neutral pictures was pre-selected by a research assistant. In some situations (n = 4), the child could not identify a sufficient number of emotionally neutral pictures from the IAPS pool and/or enough pictures containing people (see below). In such cases, the clinician worked collaboratively with child to find additional emotionally neutral pictures via web search.

The clinician ensured that threat and neutral pictures were matched in number of pictures containing people. In addition, the clinician made an effort to match threat and neutral pictures on shape, color, and complexity, although this was not ensured using systematic or objective criteria. To better allow for picture matching as well as to minimize participant time burden, the clinician generally collected more neutral pictures than required in order to allow for more time and options in picture matching between appointments. The clinician and/or a research assistant inputted all idiographic pictures into the AAT program and tested the program prior to use with participants.

3.6 Preprocessing of Reaction Time Data

Traditional outlier handling. Reaction time outliers were handled in a manner consistent with our previous research (Kuckertz et al., 2015). Trials were removed in the following order (total: 15.1%): incorrect trials (4.1%), reaction times <500ms or >2,500ms (6.5%), and reaction times more than two standard deviations above or below each individual's mean (4.4%). The lowest accuracy for any participant was 87.5% (above *a priori* cutoff of 85%) and thus all participants were retained for analysis.

Winsorized outlier handling. Although not yet applied to analysis of automatic action tendencies, recent recommendations for analysis of reaction time data in cognitive bias paradigms have emphasized a specific rescaling approach (Winsorizing) for handling outliers (Erceg-Hurn & Mirosevich, 2008; Price et al., 2015). In this approach, inaccurate trials are removed and reaction time outliers are defined as responses that are either 1.5 times the interquartile range below the 25^{th} percentile or above the 75^{th} percentile. Outliers are then rescaled to the lowest or highest value that falls within 1.5 times the interquartile range from the 25^{th} or 75^{th} percentile.

Child age. I examined whether age was associated with (a) error rates or (b) AAT bias scores. I planned to include child age as a covariate in the analyses if found to be significantly associated with these variables.

Sections of Chapter 3 of this dissertation will be submitted for publication with co-author, Amir, Nader. The dissertation author was the primary investigator and will be the primary author on this publication.

CHAPTER 4: RESULTS

4.1 Participant Demographics

Participants (*N* = 17) ranged in age from 8 to 16 years (*M* = 11.65, *SD* = 2.29) and included seven females and 10 males. Fifteen participants self-identified as white and two participants identified as mixed race. Twelve participants identified as Non-Hispanic and five participants identified as Hispanic. Participants' parents had completed a mean of 14.94 years of education (*SD* = 2.56). Thirteen parents were married, three were separated or divorced, and one was non-married but cohabitating.

4.2 Clinical Characteristics

Clinical symptoms are presented in Table 1. All participants had a primary diagnosis of OCD and had a mean of 2.53 (*SD* = 1.12) total diagnoses. Co-occurring diagnoses included generalized anxiety disorder (*n* = 5), attention-deficit hyperactivity disorder (*n* = 5), social anxiety disorder (*n* = 4), specific phobia (*n* = 4), oppositional defiant disorder (*n* = 3), separation anxiety disorder (*n* = 2), post-traumatic stress disorder (*n* = 1), major depressive disorder (*n* = 1), and motor tic disorder (*n* = 1). Mean CYBOCS score was 26.76 (*SD* = 4.55), indicating moderate to severe symptoms (Lewin et al., 2014). Mean CYBOCS scores for the current study fell within one standard deviation of the mean for baseline CYBOCS in typical clinical trials for children with OCD, see Figure 2. Clinician, child- and parent-rated CYBOCS scores were similar in mean and standard deviation, see Table 1.

4.3 AAT Preliminary Analyses

AAT overall accuracy and reaction times. Participants were highly accurate in their responding (95.86% mean accuracy), similar to our previous research examining

AAT biases among clinically anxious children (94.86% mean accuracy; Kuckertz et al., 2015). After exclusion of outliers as described in Section 3.6, overall mean participant reaction time was 952ms (*SD* = 242). Winsorizing reaction times rather than excluding outliers resulted in an overall mean reaction time of 1009ms (*SD* = 248).

Relationship between participant age and AAT variables. The correlation between participant age and accuracy did not reach significance, $r(17) = .31$, $p = .228$, nor did the any correlations between age and bias scores (*r*s = -.13 to .22, *p*s = .393 to .947). Because age was not significantly correlated with accuracy or bias scores, it was not included as a covariate in subsequent analyses.

Reliability of AAT reaction times and bias scores. To understand better the reliability of bias scores, I first examined to what extent individual reaction times comprising each bias score (1) were themselves reliable, and (2) correlated with each other.

I examined split-half reliability of individual reaction times based on odd vs. even trials as well as first half vs. second half of trials for both traditional means as well as winsorized means. These data are presented in Table 2 along with means and standard deviations for each reaction time type. Overall, individual reaction times were highly reliable (range: *r*s = .84 to .98, *p*s < .001).

Next I examined the correlations between individual reaction time components comprising each bias score. Correlations between components were high, *r*s = .92 to .96, *p*s < .001 (Table 3).

Reliability varied by bias score, outlier handling method, and split-half method (Table 3). Among the combinations examined, the two highest reliability coefficients were observed for approach bias using traditional outlier handling (first vs. second half, r = .84; odd vs. even trials, r = .68). The reliability ranged for avoidance bias scores, rs = .14 to .59; threat AA bias scores, rs = .28 to .51; and neutral AA bias scores, rs = .33 to .47. Thus, reliability was poor for all bias scores other than approach bias.

4.4 Characterization of AAT Bias Scores (Aim 1)

Reaction times for each trial type are presented graphically in Figure 3.

Approach bias. Participants were significantly faster to pull threat-related pictures than they were to pull neutral pictures, $t(16) = -2.19$, $p = .043$, $d = -0.53$. The mean difference (M_{diff}) between pulling threat and neutral pictures was -45ms ($SD = 85$). This effect was non-significant using winsorized means, $t(16) = -1.39$, $p = .184$, $d = -0.34$, $M_{diff} = -25$, $SD = 74$.

Avoidance bias. Participants did not significantly differ in reaction times for pushing threat compared to neutral pictures using either traditional, $t(16) = -0.45$, $p = .657$, $d = -0.11$, $M_{diff} = -8$, $SD = 75$, or winsorized outlier handling, $t(16) = 0.85$, $p = .410$, $d = 0.21$, $M_{diff} = 21$, $SD = 104$.

Threat AA bias. Participants did not significantly differ in reaction times for pushing threat compared to pulling threat pictures using either traditional, $t(16) = 1.12$, $p = .280$, $d = 0.27$, $M_{diff} = 20$, $SD = 74$, or winsorized outlier handling, $t(16) = 1.09$, $p = .291$, $d = 0.26$, $M_{diff} = 23$, $SD = 85$.

Comparison of threat AA bias and neutral AA bias. Participants demonstrated significantly larger AA bias scores for threat relative to neutral pictures, indicating that participants demonstrated a stronger relative tendency to pull rather than to push threat pictures compared to their responses to neutral pictures. This effect was significant using both traditional, $t(16) = 3.13$, $p = .006$, $d = 0.76$, $M_{diff} = 37$, $SD = 49$, as well as winsorized outlier handling, $t(16) = 2.55$, $p = .021$, $d = 0.62$, $M_{diff} = 46$, $SD = 75$.

4.5 Associations Between AAT Bias Scores and OCD Symptoms (Aim 2)

Correlations between AAT bias scores and OCD symptoms are presented in Table 4. No correlations approached statistical significance for the clinician-rated CYBOCS, although several correlations between bias scores with child-rated CYBOCS and parent-rated CYBOCS were marginally statistically significant ($p < .10$).

CYBOCS correlation with approach bias. Clinician-rated CYBOCS scores did not significantly correlate with approach bias scores using either traditional, $r(17) = .18$, $p = .501$, or winsorized outlier handling, $r(17) = -.15$, $p = .574$. Furthermore, neither child- nor parent-rated CYBOCS significantly correlated with approach bias using either outlier handling method (*r*s = -.27 to -.37, *p*s = .154 to .330).

CYBOCS correlation with avoidance bias. Clinician-rated CYBOCS scores did not significantly correlate with avoidance bias scores using either traditional, $r(17) = .19$, $p = .460$, or winsorized outlier handling, $r(17) = -.30$, $p = .250$. Furthermore, neither child- nor parent-rated CYBOCS significantly correlated with avoidance bias (*r*s = -.01 to -.45, *p*s = .068 to .985). However, the correlation between child-rated CYBOCS and avoidance bias with winsorized outlier handling was marginally significant, $r(17) = -.45$, $p = .068$), suggesting that greater tendency to push threat pictures more quickly than neutral pictures was associated with greater symptom severity.

CYBOCS correlation with threat AA bias. Clinician-rated CYBOCS scores did not significantly correlate with threat AA bias scores using either traditional, $r(17) = -.01$, $p = .979$, or winsorized outlier handling, $r(17) = -.02$, $p = .935$. Furthermore, neither child- nor parent-rated CYBOCS significantly correlated with threat AA bias (*r*s = .01 to -.47, *p*s = .057 to .973). However, the correlation between child-rated CYBOCS and threat AA bias with winsorized outlier handling was marginally significant, $r(17) = -.47$, $p = .057$), suggesting that faster tendency to push than to pull threat pictures was associated with greater symptom severity.

Sections of Chapter 4 of this dissertation will be submitted for publication with co-author, Amir, Nader. The dissertation author was the primary investigator and will be the primary author on this publication.

CHAPTER 5: DISCUSSION

Though previous research has examined the presence of automatic action tendencies (i.e., approach and avoidance biases) in individuals experiencing psychopathology, to date these tendencies have not been examined among individuals with OCD nor using idiographically-selected stimuli. In this pilot study, children diagnosed with OCD worked collaboratively with their parent and a clinician to identify threat and neutral picture stimuli relevant to their specific OCD feared situations, following which they completed an AAT using these stimuli. Thus, I examined the feasibility, reliability, and preliminary validity of the AAT in this sample.

5.1 Feasibility and Relevance of Idiographic Procedure

This pilot study supports the feasibility of collecting idiographic picture stimuli with children with OCD. All participants were able to identify an appropriate number of threat and neutral pictures for use in the task. Moreover, a subset of participants rated threat pictures as significantly more threatening than neutral pictures, thus providing a basis for which to expect reaction time differences to emerge across valence type comparisons.[5]

Recent reviews highlight the importance of utilizing disorder-relevant stimuli in cognitive bias studies (Pergamin-Hight, Naim, Bakermans-Kranenburg, van IJzendoorn, & Bar-Haim, 2015), particularly for OCD (Hezel & McNally, 2016). In a meta-analytic review of attentional biases, Pergamin-Hight et al., 2015 reported that attentional biases were larger in effect size for disorder-relevant threat versus general threat stimuli (i.e., general or specific to a different disorder). Moderator analyses by anxiety disorder were

[5] Picture ratings were added to the protocol for the second larger study from which these data were obtained ($n = 11$). Participants rated threat pictures as significantly more negative than neutral pictures, $t(10) = -8.03$, $p < .001$, $d = -2.42$.

consistent with this effect for all disorders examined (post-traumatic stress disorder, panic disorder, social anxiety disorder), with the exception of OCD. The disorder-relevant threat effect for OCD was not significant in that study, perhaps because the four included studies examining attentional bias in OCD did not utilize idiographic stimuli for the disorder-relevant stimuli (Foa, Ilai, McCarthy, Shoyer, & Murdoch, 1993; Kampman, Keijsers, Verbraak, Näring, & Hoogduin, 2002; Kyrios & Iob, 1998; Olatunji, Ciesielski, & Zald, 2011). Thus, the stimuli chosen by investigators at the group level may not have been sufficiently relevant for individual participants with OCD and hence not differentiated in terms of bias elicited compared to general threat stimuli.

Idiographic stimuli were obtained at the beginning of a treatment preparation session at the same time as when I collected an exposure hierarchy from participants as part of the larger study. Prior to this session, I asked families to select idiographic pictures and create a preliminary exposure hierarchy. The majority of participants selected pictures that closely represented situations included on their exposure hierarchy. This procedure may have facilitated collection of threat-relevant pictures, as participants had already accepted the rationale for ERP and thus may have been more willing to complete the often anxiety-provoking procedure of obtaining threat pictures than if they were not preparing for this form of treatment. Moreover, it may have been easier for participants to generate ideas for threat-relevant pictures given that they were drafting an exposure hierarchy simultaneously.

5.2 Reliability of AAT Bias Scores

With few exceptions (Reddy et al., 2016; Reinecke et al., 2010; Rinck & Becker, 2007), studies have not reported the reliability of AAT bias scores. The issue of measurement reliability for cognitive bias tasks has gained increasing attention in recent years (Price et al., 2015; Rodebaugh et al., 2016), along with an emphasis on factors that influence the reliability of difference scores (Rodebaugh et al., 2016). Unless the two individual component scores of the difference scores have unequal variances (Trafimow, 2015), the reliability of a difference score will be determined by the reliability of the two component scores as well as the correlation between the component scores (Furr & Bacharach, 2014).

In this study, split-half reliability coefficients for individual reaction time measures (pull threat, pull neutral, push threat, push neutral) were high (*r*s = .84 to .98). This suggests that overall, participants were consistent in their responding to idiographically-selected stimuli and thus support the use of idiographic stimuli when attempting to maximize reliability. Nonetheless, individual reaction time measures that demonstrated only slightly relatively higher reliability (e.g., for pulling) may confer more meaningful benefits for the reliability of the difference score given that the relationship between individual component reliability and difference score reliability is non-linear (Furr & Bacharach, 2014, Figure 6.4).

While the individual component reliability coefficients were promising in terms of maximizing reliability of bias scores, the correlation between component scores for the various bias indices were high (*r*s = .92 to .96). This suggests that overall, participants' responses to all picture types and response directions were highly associated. As the two component scores increasingly provide similar information (i.e., higher correlations), the difference between them is less likely to provide consistent information (i.e., lower bias reliability) (Furr & Bacharach, 2014).

Evidence supporting the reliability of AAT bias scores was mixed. The split-half reliability for approach bias scores using traditional outlier handling was acceptable to good (odd vs. even trials, r = .68; first vs. second half, r = .84). However, all remaining bias scores and calculation methods ranged from r = .14 to .59. These correlations suggest that further work is needed to increase the reliability of AAT bias scores.

Demonstration of reliability is important in studies seeking to examine individual differences in a phenomenon, such as the current study (Aim 2). Indeed, studies of cognitive bias and CBM research has been focused on applications such as relationship between bias and symptoms (Cousijn et al., 2011; Kuckertz et al., 2015), prediction of who will respond to treatment based on bias (Amir, Taylor, & Donohue, 2011; Kuckertz et al., 2014), and mediation of treatment effects via bias change (A. Heeren, Reese, McNally, & Philippot, 2012; Price et al., 2016). While reliability is also important for more experimental applications, demonstration of a phenomenon (e.g., differences in responding across groups or across stimulus types) is impacted by poor reliability to a lesser degree (Nunnally, 1978; Rodebaugh et al., 2016). As cognitive bias research was borne out of experimental and social psychology literatures, it is perhaps not surprising that issues of reliability have garnered greater attention as these tasks become adopted by researchers examining clinical applications.

5.3 Examination of Automatic Approach and Avoidance Biases

Consistent with results from initial studies examining AAT biases among individuals with spider fear (Rinck & Becker, 2007), social anxiety (Heuer et al., 2007) and problem drinking (R. W. Wiers et al., 2009), I hypothesized that participants would be faster to push (i.e., avoid) than to pull (i.e., approach) threat pictures, and that this relative approach-avoidance (AA) difference would be more negative for threat pictures than for neutral pictures. Results did not support these hypotheses. The difference between pushing and pulling threat pictures was non-significant, and while the threat AA bias was significantly different than the neutral AA bias, the direction was opposite to what I hypothesized. That is, the AA bias was significantly more positive (i.e., faster to pull versus push pictures) for threat compared to neutral pictures.

As explained by Najmi and colleagues (2010), comparison of responses to threat and neutral stimuli separately within each response direction may allow for more precise delineation of the nature of approach and/or avoidance biases in a given population. Although I hypothesized that participants would be slower to pull threat compared to neutral pictures, I found the opposite statistically significant pattern. While a previous study of individuals with subclinical contamination fears found that participants demonstrated difficulty approaching threat pictures, other AAT studies with anxious individuals find the opposite pattern. For example, Kuckertz and colleagues (2017) found that adults diagnosed with social anxiety disorder were slower to pull neutral compared to unambiguously threatening faces. The authors interpreted these findings as supporting the hypothesis that neutral faces were more ambiguous and hence may be more threatening for socially anxious individuals relative to threat faces that may be universally unpleasant and nonambiguous. However, participants in that study did not complete picture valence ratings so it was not possible to confirm that interpretation.

Several potential explanations exist for this pattern whereby anxious individuals demonstrated speeded approach. Some research suggests that positive and negative stimuli do not inherently facilitate the acts of arm flexion and arm extension, respectively (for a review see Phaf et al., 2014) but rather that these are dictated by interpretation and explicit instructions to participants. While visual simulation of approach or avoidance was created by adding a “zooming” feature, it is possible that this manipulation was insufficient to render a feeling of approach. Moreover, in the current study I did not explicitly instruct participants to interpret response movement, as all instructions were referent to the direction of the joystick rather than the participant (e.g., “if the border is green, you should pull the joystick”). As the majority of videogames use joysticks such that pushing the joystick forward advances the character towards objects in the game whereas pulling the joystick backwards allows the character to retreat, children in the current study may have been predisposed to this interpretation.

Alternatively, it may be the case that under certain conditions, clinically anxious individuals do respond to threat stimuli with speeded approach. That is, the context of the studies may impact the direction of approach bias scores. For example, Voncken and colleagues (2012) found that socially anxious participants were slower to pull faces towards them compared to non-social stimuli. However, this pattern was reversed when participants were given the instructions that they would have a conversation with the person portrayed in the picture following completion of the AAT. Similarly, in the current study participants were unintentionally primed with anticipation of feared situations, given that the idiographic threat stimuli matched closely to situations on the exposure hierarchy which participants were aware that they would begin approaching in the following session. Similarly, research has demonstrated that activation of fear impacts the direction of other forms of cognitive bias as well (Amir et al., 1996; Garner, Mogg, & Bradley, 2006; Mansell, Ehlers, Clark, & Chen, 2002; Mathews & Sebastian, 1993).

Finally, results provided no evidence for the presence of an avoidance bias. While caution is warranted given that this study was powered only to detect medium- to large-sized effects, previous studies have similarly failed to find avoidance biases among anxious individuals (Kuckertz et al., 2015, 2017; Najmi et al., 2010; Voncken et al., 2012). From a clinical perspective, when participants describe being avoidant they more commonly provide examples in which they fail to approach or engage in situations that could provoke anxiety, rather than actively escaping from anxiety-provoking situations in which they find themselves or situations which they have already chosen to approach.

5.4 Validity of AAT Bias Scores

Aim 2 of the study sought to examine the criterion validity of AAT bias scores by examining their associations with OCD symptom severity. The current study was adequately powered only to detect statically significant correlations of large effect size (r = .62), and thus I did not expect small or medium sized correlations to reach statistical significance. While no correlations between bias scores and symptoms reached statistical significance, there was a trend-level correlation suggesting that faster pushing of threat relative to neutral pictures was associated with greater child-rated OCD symptom severity. Similar effects have been found among clinically anxious children for the relationship between avoidance bias and clinician-rated anxiety severity (Kuckertz et al., 2015). Nonetheless, trend-level correlations observed in the current study should be interpreted with caution and future studies should recruit larger sample sizes to examine the presence of small and medium sized effects.

5.5 Summary

The current study demonstrates the feasibility of collecting idiographic stimuli from youth diagnosed with OCD, which had not yet been established in previous studies. The importance of utilizing idiographic and/or personalized stimuli in cognitive bias research has been highlighted in recent reviews (Hezel & McNally, 2016; Pergamin-Hight et al., 2015). This issue may be of particular relevance to OCD, a disorder in which participants demonstrate heterogeneous clinical presentations. Moreover, the current study sought to address and further delineate issues related to the reliability of AAT bias scores. While approach bias scores demonstrated acceptable or good split-half reliability depending on calculation method, the majority of bias scores and calculation methods yielded poorer reliability than ideal. Despite high component reliability of individual reaction times, lower reliability of the bias scores may have been the result of high correlations between components. I found statistically significant differences between pulling threat and pulling neutral stimuli (approach bias) as well as between threat AA and neutral AA biases. However, these effects were in the opposite direction as predicted. This may reflect a failure of the zooming feature to sufficiently create an interpretation of approach, or may have been a result of participants being primed to approach threat because they were also enrolled in a larger ERP study. Participants did not differ in response latencies for pushing threat versus neutral stimuli or in pushing versus pulling threat stimuli. Finally, no correlations between bias scores and OCD symptoms reached statistical significance.

5.6 Limitations and Future Directions

This pilot study represented an attempt to demonstrate initial feasibility, reliability, and preliminary validity of an idiographic AAT. As such, a number of limitations warrant further elaboration. Most notably, the sample size was small (*N* = 17) and thus the study was only powered to detect medium to large effects (*r*s > .62, *d*s > 0.73).

Most bias scores failed to achieve acceptable levels of split-half reliability, which can be particularly problematic for individual differences research such as Aim 2 of the current study (Nunnally, 1978; Rodebaugh et al., 2016). Given that the approach bias score demonstrated adequate to good reliability, there is some confidence in interpreting observed effects related to this measure. However, only when researchers demonstrate the reliability of avoidance bias scores and/or relative AA scores can researchers adequately examine the relationship of these measures with symptoms.

Our study included participants who ranged in age from 8-16 years. Previous research has demonstrated differences in the direction of cognitive biases among younger versus older youth (Carmona et al., 2015; Lonigan & Vasey, 2009; Reinholdt-Dunne, Mogg, Esbjorn, & Bradley, 2011). Due to small sample size, I did not conduct analyses with younger versus older youth separately. Further research with larger samples should compare younger versus older youths not only on the magnitude and direction of hypothesized effects, but also on task feasibility, reliability, etc.

While core etiological features are likely to underlie the disorder (e.g., Obsessive Compulsive Cognitions Working Group, 1997, 2003), patients with OCD present with observably heterogeneous symptoms within and across subtypes. The current study sought to address this issue with the use of idiographic stimuli. Nonetheless and although not systematically measured in the current study, it may be the case that participants with more abstract fears (e.g., if I do not tap three times unspecified bad events will happen to me in the future) relative to those with more concrete fears (e.g., if

I am around a knife I will lose control and stab someone) had greater difficulty identifying pictures that maximized threat valence. Continued research should examine to what extent participants vary in their ability to collect idiographic stimuli as well as to develop procedures to facilitate stimuli collection for more abstract OCD fears.

Finally, in the current study I assessed for only one form of cognitive bias – automatic action tendencies. However, research suggests that cognitive biases do not exert their effects in isolation, but rather as cumulative and/or interactive effects (Amir, Bomyea, & Beard, 2010; Hirsch, Clark, & Mathews, 2006; LeMoult & Joormann, 2012). For example, it is possible that attentional biases differentially impacted the speed with which participants initiated responses to threat versus neutral stimuli. With few exceptions (Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015), researchers have not yet examined the relationship with and impact of approach-avoidance biases on other forms of cognitive bias. Moreover, while many forms of cognitive bias are demonstrated in many individuals with OCD, distinct bias profiles emerge across individuals (Hezel & McNally, 2016). As such, research that examines the interrelationships and interactive effects of cognitive biases may allow for greater specificity and individualization of intervention programs, consistent with a personalized medicine approach (Insel, 2009).

Pending progress in the aforementioned areas, an improved understanding of automatic action tendencies among children with OCD has important clinical implications. Many children with OCD fail to respond to ERP treatment (POTS, 2004), suggesting that factors beyond deliberative approach of threat may warrant direct modification. Automatic action tendencies may be intervened upon in a number of ways.

For example, research from the social psychology literature suggests that raising awareness of one's own automatic racial biases may allow for more deliberative efforts to avoid prejudiced behavior, and in turn, reduce automatic racial biases and raise one's concern about discrimination towards people of color (Devine, Forscher, Austin, & Cox, 2012). Moreover, researchers have successfully modified automatic action tendencies through computerized training programs by manipulating contingencies between required response and stimulus type (Amir et al., 2013; Taylor & Amir, 2012; R. W. Wiers et al., 2011). Although such research should be contingent upon establishing reliable and valid indicators of the biases targeted through intervention, these areas represent exciting potential directions for future research.

Sections of Chapter 5 of this dissertation will be submitted for publication with co-author, Amir, Nader. The dissertation author was the primary investigator and will be the primary author on this publication.

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Table 1. Clinical Characteristics of Sample

	N	Mean	SD
Number of Diagnoses	17	2.53	1.12
CGI-S	16	4.44	0.96
CYBOCS	17	26.76	4.55
CYBOCS-C	17	25.06	4.64
CYBOCS-P	15	25.53	4.19
SCARED-C	17	29.18	14.06
SCARED-P	17	27.59	15.03
MFQ-C	17	19.71	12.65
MFQ-P	17	19.35	12.92

Note. CGI-S = Clinical Global Impression-Severity; CYBOCS = Children's Yale Brown Obsessive Compulsive Scale (clinician-rated version); CYBOCS-P = CYBOCS parent-rated version; CYBOCS-C = CYBOCS clinician-rated version; SCARED-C = Screen for Child Anxiety Related Disorders child-rated version; SCARED-P = SCARED parent-rated version; MFQ-C = Mood and Feelings Questionnaire child-rated version, MFQ-P = MFQ parent-rated version. Missing data for CGI-S (n = 1) and CYBOCS-P (n = 2) is due to administrative error.

Table 2. Means, Standard Deviations, and Split-Half Reliability of AAT Reaction Times

	Mean (SD)	Odd-Even	First-Second Half
Pull Threat (Traditional)	928 (240)	.97	.98
Pull Threat (Winsorized)	996 (245)	.98	.89
Push Threat (Traditional)	948 (229)	.96	.87
Push Threat (Winsorized)	1019 (247)	.95	.84
Pull Neutral (Traditional)	973 (274)	.98	.97
Pull Neutral (Winsorized)	1021 (261)	.96	.90
Push Neutral (Traditional)	957 (248)	.94	.91
Push Neutral (Winsorized)	998 (265)	.98	.93

Note. All *p*s for reliability < .001. $N = 17$.

Table 3. Descriptive Statistics and Reliability of AAT Bias Scores

	Mean (SD)	Components *r*	Odd-Even	First-Second Half
Approach Bias (Traditional)	-45 (85)*	.95***	.68**	.84***
Approach Bias (Winsorized)	-25 (74)	.96***	.53*	.38
Avoidance Bias (Traditional)	-8 (75)	.95***	.14	.16
Avoidance Bias (Winsorized)	21 (104)	.92***	.59*	.38
Threat AA Bias (Traditional)	20 (74)	.95***	.44†	.28
Threat AA Bias (Winsorized)	23 (85)	.94***	.50*	.51*
Neutral AA Bias (Traditional)	-17 (76)	.96***	.38	.47†
Neutral AA Bias (Winsorized)	-24 (74)	.96***	.46†	.33

Note. ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$. $N = 17$.

Table 4. Correlations Between AAT Bias Scores and OCD Symptoms

	CYBOCS	CYBOCS-C	CYBOCS-P
Approach Bias (Traditional)	.18	-.36	-.27
Approach Bias (Winsorized)	-.15	-.30	-.37
Avoidance Bias (Traditional)	.19	-.39	-.17
Avoidance Bias (Winsorized)	-.30	$-.45^{\dagger}$	-.01
Threat AA Bias (Traditional)	-.01	-.17	-.34
Threat AA Bias (Winsorized)	-.02	$-.47^{\dagger}$	.01

Note. $^{\dagger}p < .10$. $N = 17$ for correlations with CYBOCS and CYBOCS-C, $N = 15$ for correlations with CYBOCS-P.

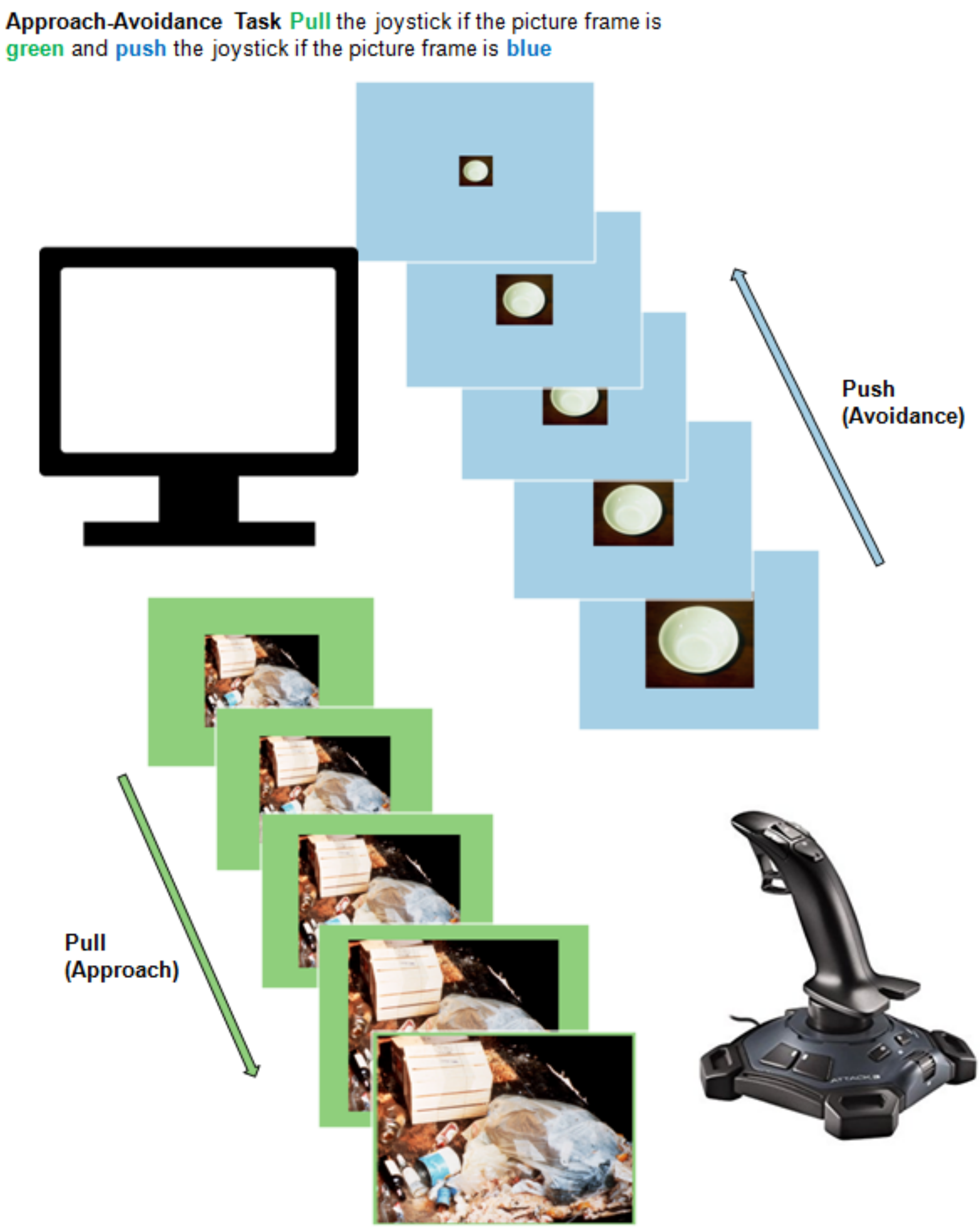


Figure 1. Approach Avoidance Task.

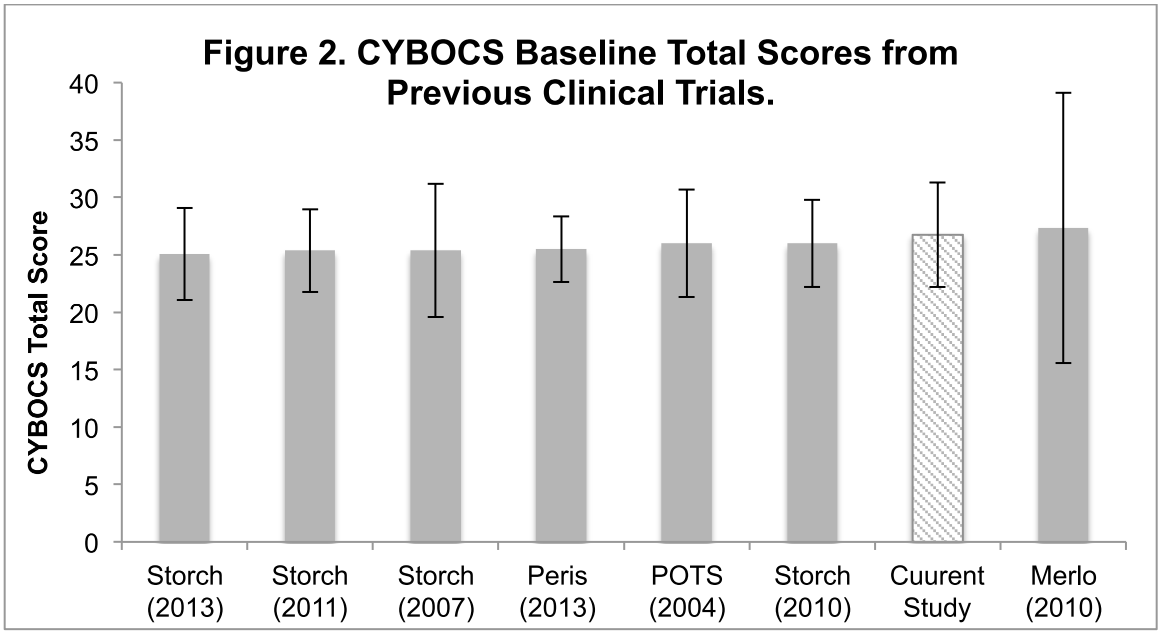
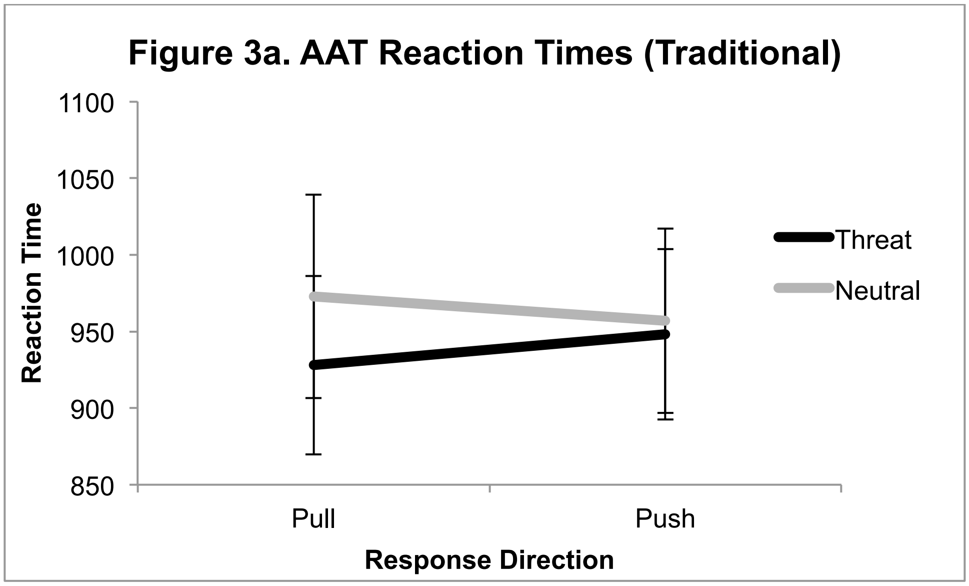


Figure 2. CYBOCS baseline total scores from previous clinical trials. CYBOCS = Children's Yale Brown Obsessive Compulsive Scale, clinician-rated version. Error bars represent standard deviations. Benchmarking studies represented in figure were reviewed in a recent meta-analysis of treatment for childhood OCD (Ost et al., 2016) and are included in the current figure if they 1) reported CYBOCS total score mean and standard deviation from a CBT condition, 2) were conducted in the USA, and 3) used a similar baseline entry criteria to current study (CYBOCS $\geq$ 16 +/- 2 points).



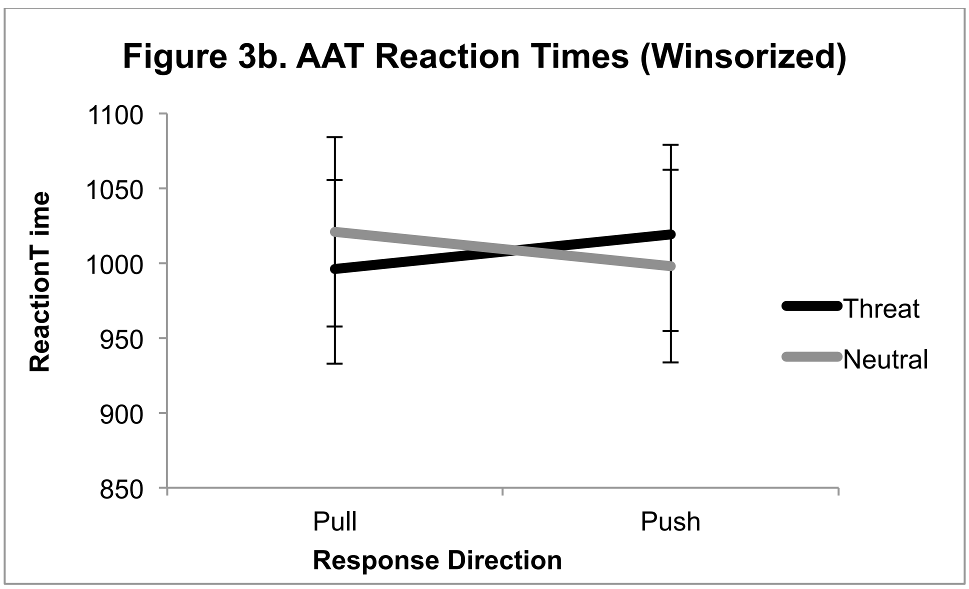


Figure 3. AAT mean reaction times and standard error for traditional (Figure 3a) and winsorized (Figure 3b) outlier handling.